

# Transit Signal Prioritization (TSP) Considerations within RTS Corridors



June 25th, 2013

# Outline

- How TSP Works
- Signal operations to support RTS
- Implementing TSP in Montgomery County
  - County Wide
  - RTS Considerations

# What is Transit Signal Priority (TSP)

**TSP is a traffic signal operational strategy that facilitates the movement of transit vehicles, either buses or streetcars, through traffic signal controlled intersections.**

- **Passive TSP** adjusts signal timing/coordination for transit operations
- **Active TSP** is used selectively and conditionally to provide passage for transit vehicles at signalized intersections when requested.

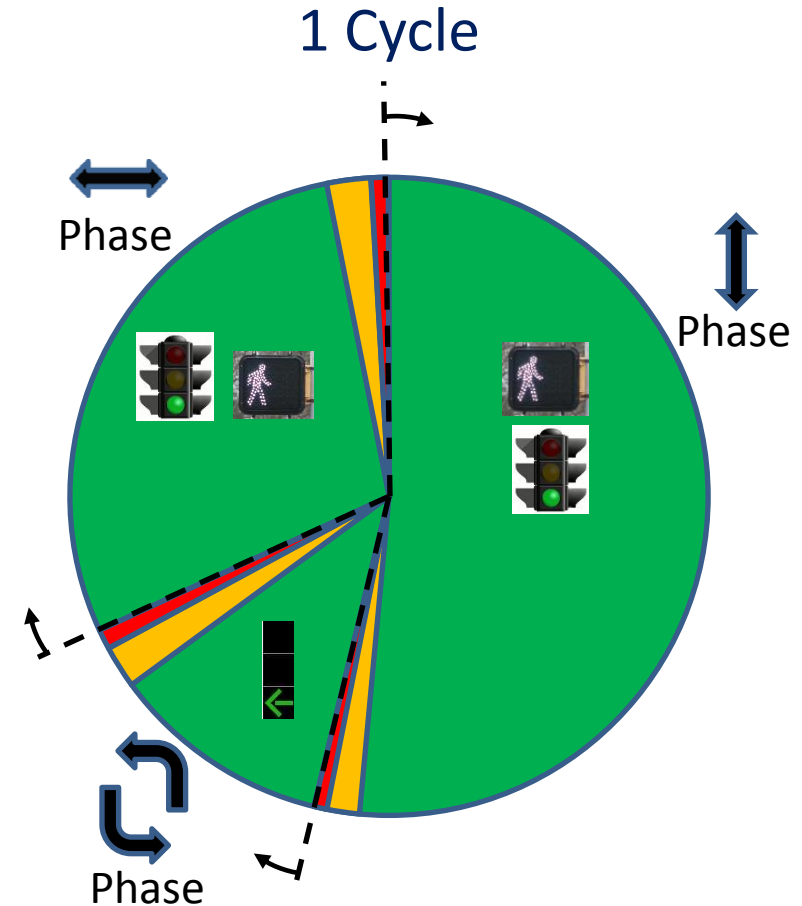
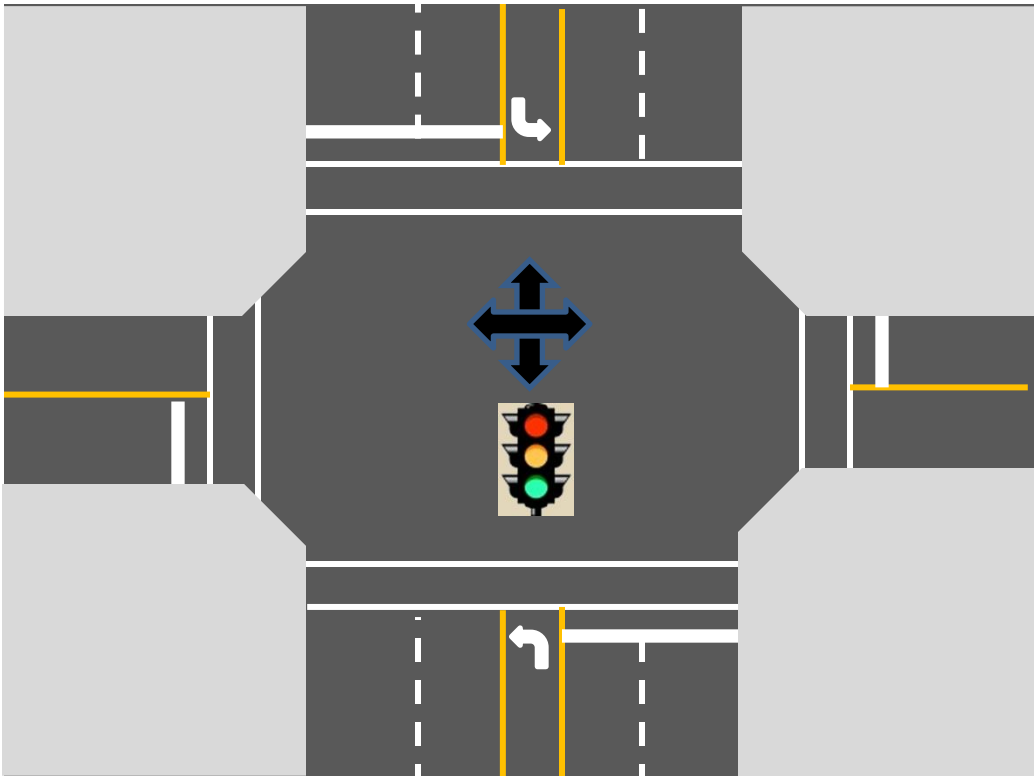


Source: TSP Handbook

***Active TSP is conditional priority, not to be confused with Emergency Vehicle Preemption which is unconditional priority***

# Traffic Signals 101

- A *Cycle* consists of multiple *Phases*
- Phases allocate time to movements competing for shared right-of-way
- Phase Length is a function of geometry, and vehicle and pedestrian volumes (demand)

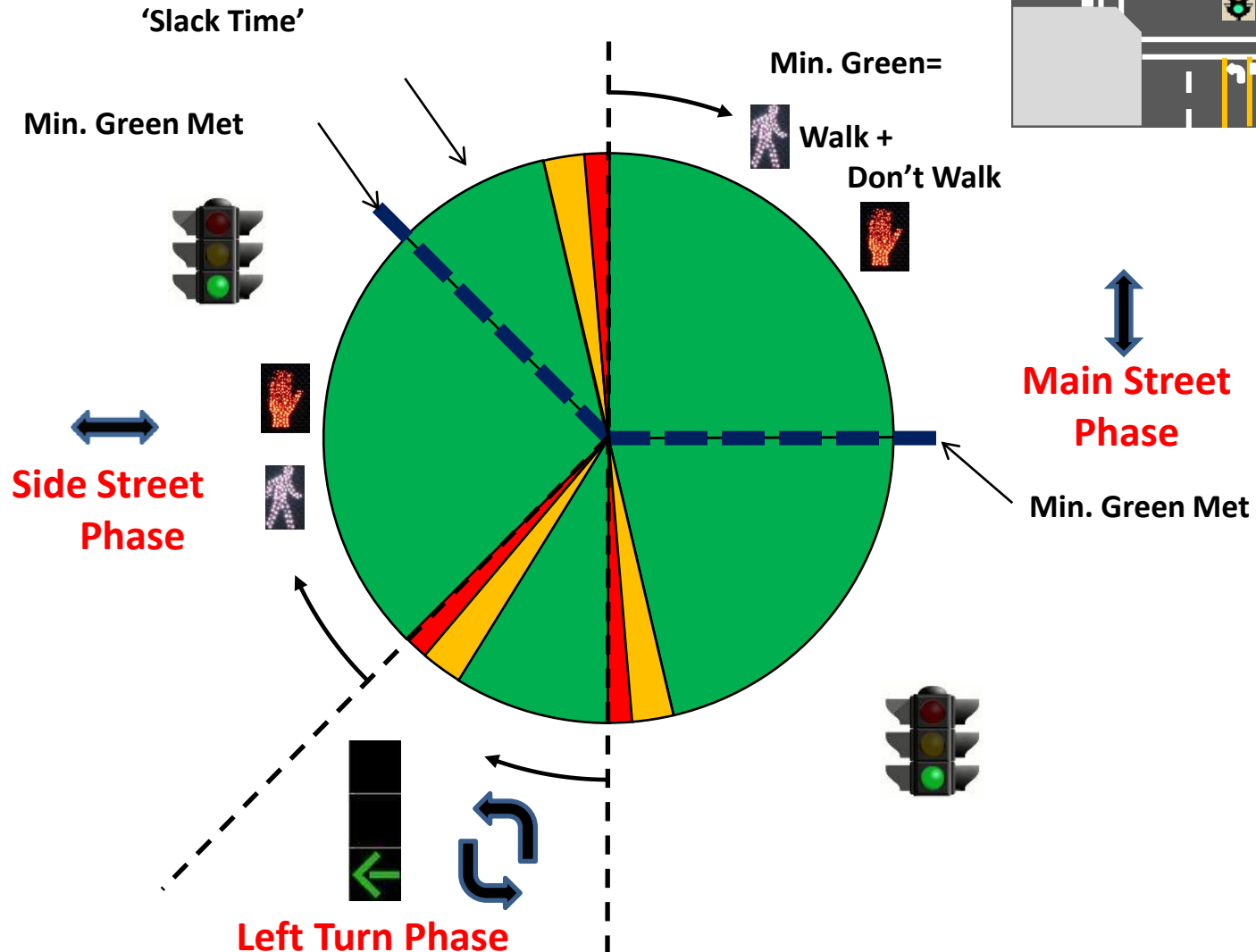


Cycle length is sensitive to many factors including coordination with adjacent signals; time of day; volume demand, and vehicle detection (e.g. loops)

# Signal Priority Options

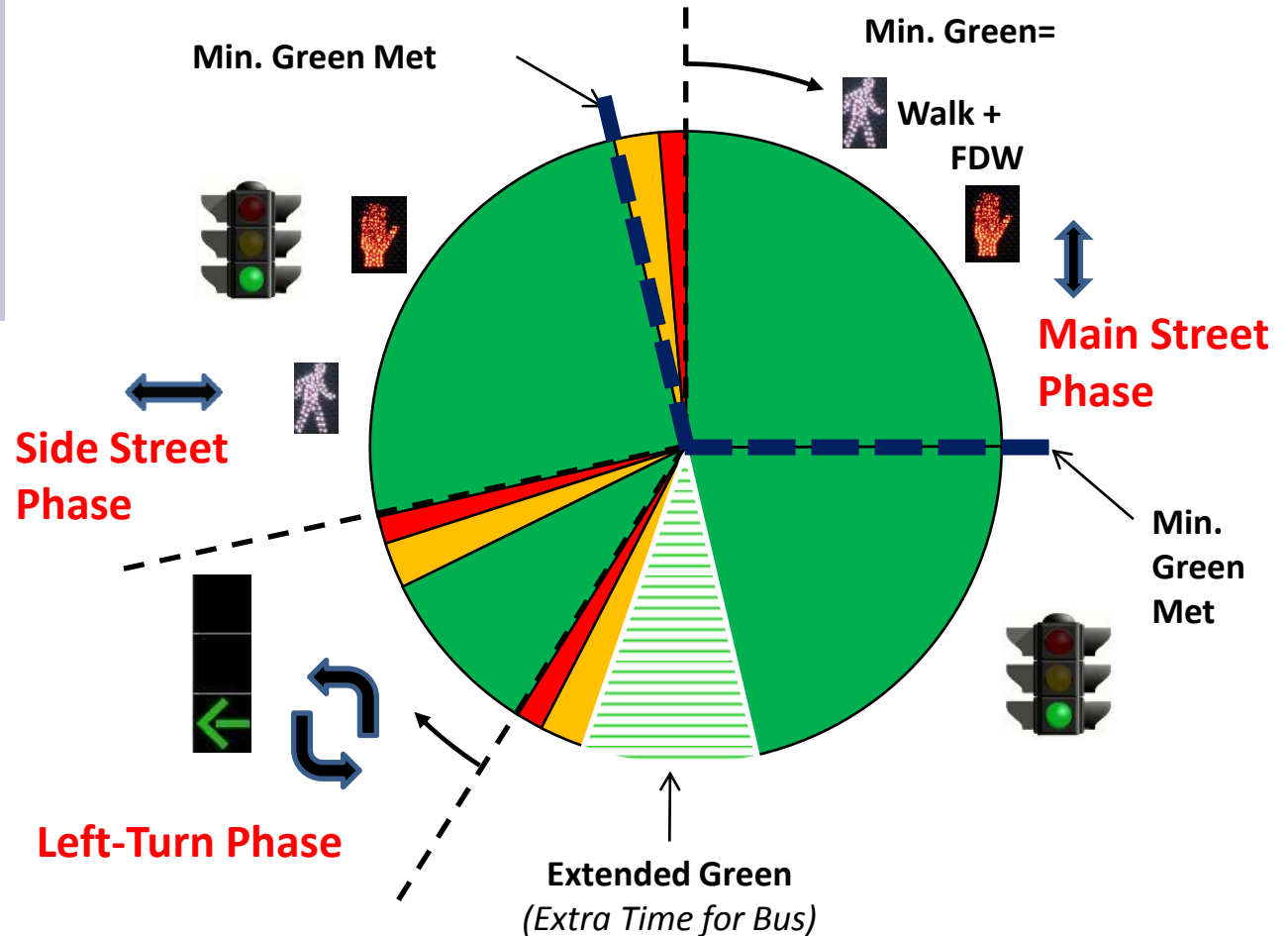
- In conjunction with no other transit priority treatments
  - Extend Green Phase
  - Truncate Red Phase
- With exclusive transit lanes or queue jump lanes
  - Passive – Adjusts signal coordination to support unimpeded flow of transit vehicles within corridor
  - Exclusive Transit Phase – Provide a transit only phase for transit vehicles at intersection

# Signal Operations without TSP



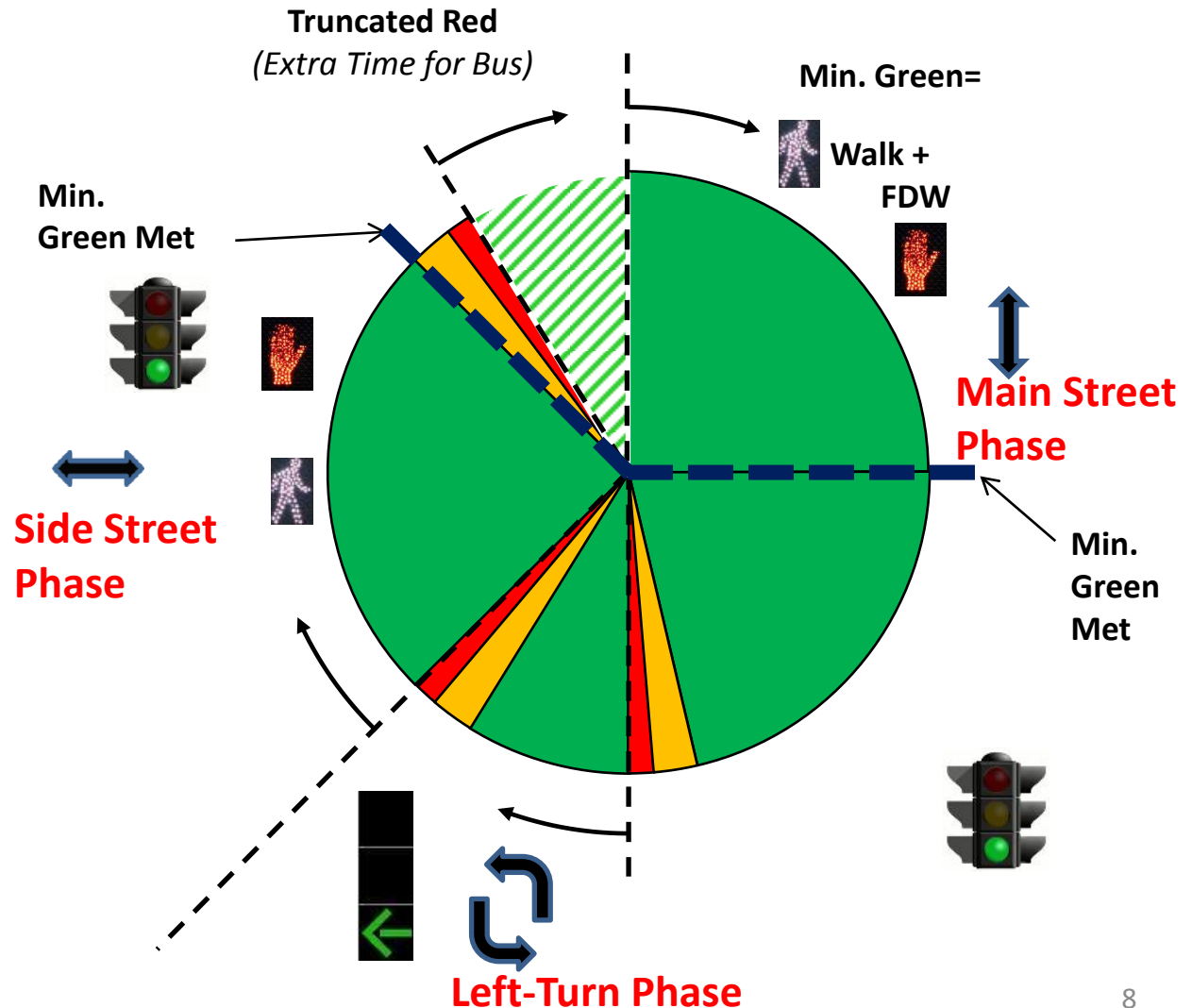
# TSP Request when Main Street is GREEN

- If a bus is approaching toward the *end* of the Phase...  
**Extend Green.**



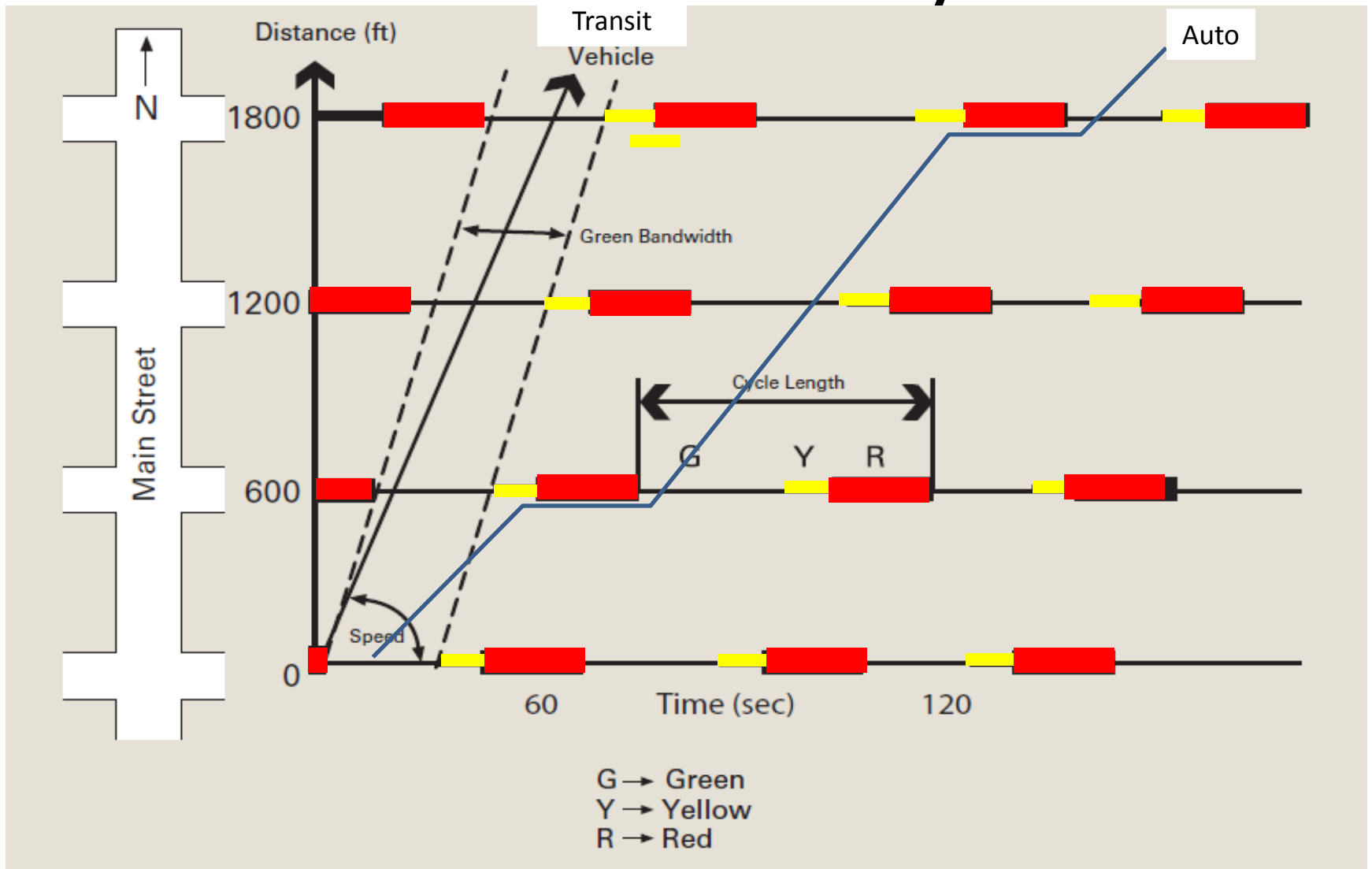
# TSP Request when the Side Street is GREEN

- If a bus is approaching before the start of the main street green, **EARLY GREEN** if the side street has served the pedestrian Walk and Don't Walk minimums



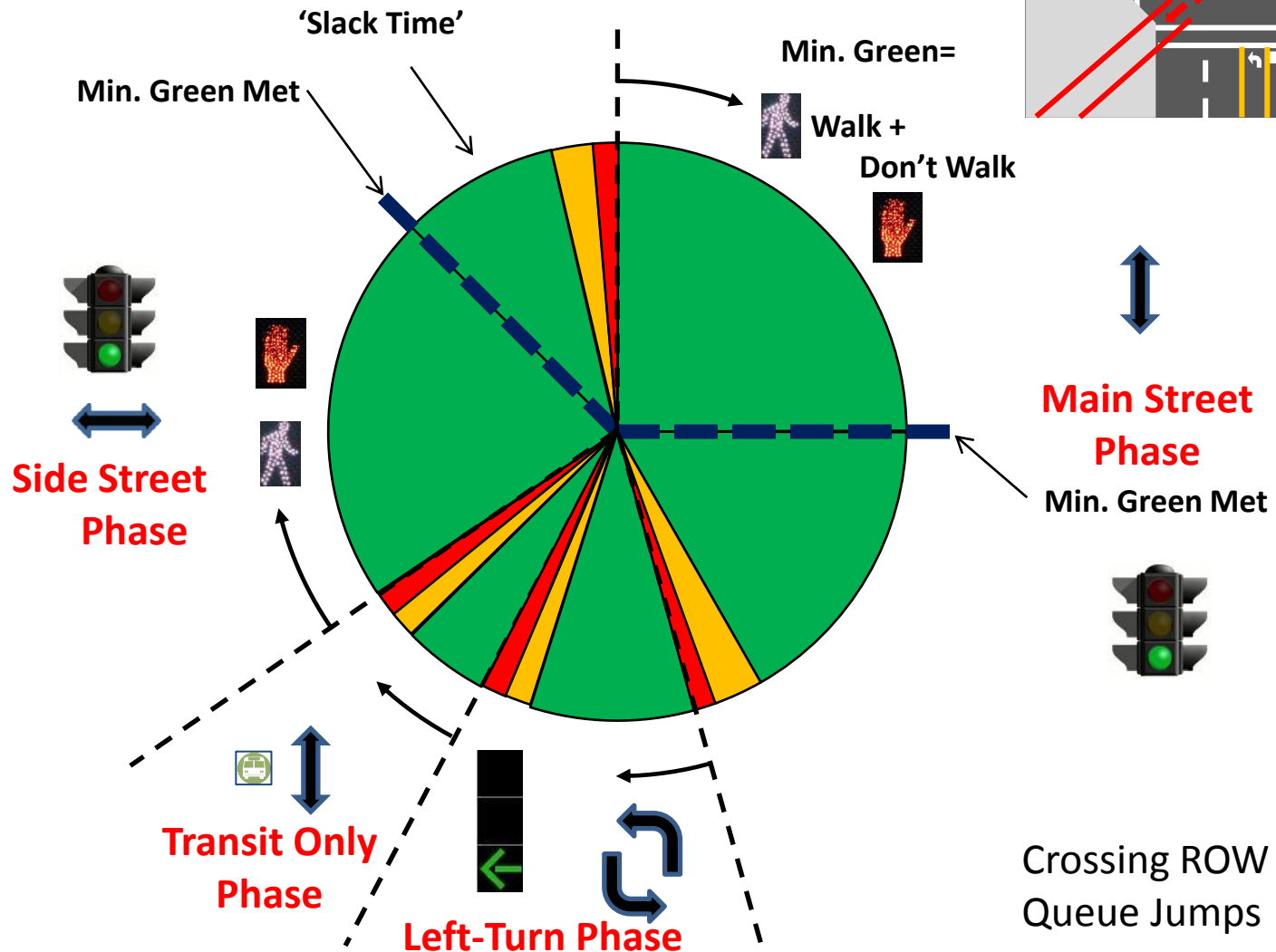


# Passive Priority



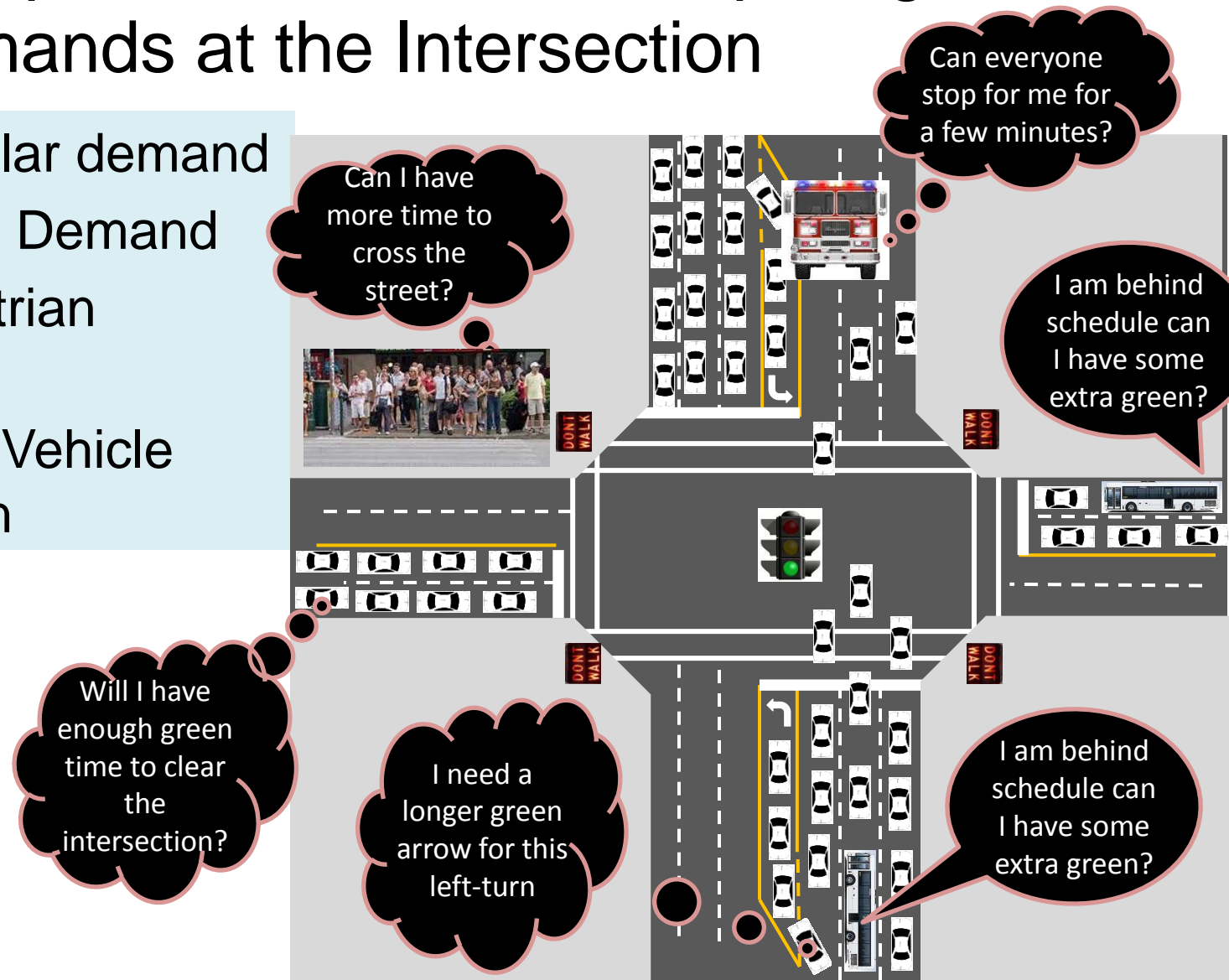
Source: TSP Handbook (FTA, 2005)

# With Transit Only Phase



# What Happens to TSP with Competing Demands at the Intersection

- High Vehicular demand
- High Transit Demand
- High Pedestrian Demand
- Emergency Vehicle Pre-Emption



# County Wide TSP

## Three Level Screening

- Corridor / Segment
  - Which bus routes and vehicles should be TSP enabled?
- Intersection
  - Which intersections should provide for TSP?
- Trip (Conditional TSP)
  - TSP provided when conditions are met:
    - Time of Day
    - Vehicle running late
    - Does not cause undo impact on traffic system operations

# Transit Characteristics

- Stop location
  - Near
  - Far
- Other Priority Treatments (existing, potential)
  - Dedicated lane
  - Queue jump
  - Bus bulbs
- Signal Delay per vehicle (by approach; AM, PM, Midday; Local, limited, express; etc.)
  - % with delay
  - Average delay
  - Distribution (will be skewed)
  - % GT X
- Transit Service
  - Vehicles per hour (by approach; AM, PM, Midday; Local, limited, express; etc.)
  - Vehicles per hour routing, straight, left, right (by approach; AM, PM, Midday; Local, limited, express; etc.)
  - Passengers per vehicle (by approach; AM, PM, Midday; Local, limited, express; etc.)
  - % Vehicle trips on time (by approach; AM, PM, Midday; Local, limited, express; etc.)
  - Impact on transit progression (do we want to tie priority together for groups of signals, e.g. Us29 at University).

# Traffic Characteristics

- Performance
  - Volume (by approach; AM, PM, Midday)
  - Intersection LOS (by approach; AM, PM, Midday)
  - Queue length, average, max (by approach; AM, PM, Midday)
  - Delay, average, max (by approach; AM, PM, Midday)
  - Volume-to-Capacity Ratio (by approach; AM, PM, Midday)
  - Available green (by approach; AM, PM, Midday)
  - Corridor/mid block LOS (is the intersection impacted by other near by intersections, is upstream congestion significant)
  - Pedestrians and bicycles per hour
- Signal
  - Controller type and capabilities
  - Coordinated ? Boundaries ?
  - Timing (phases, actuated, AM, PM, Midday)
  - cycle length
- Physical
  - Number of lanes by type and approach
  - Pedestrian and bicycle features (actuated request, bike lanes, pedestrian island, accessibility)

# Countywide TSP Objectives

- Transit:
  - Reduce Signal Delay
  - Reduce variation in time through intersection or segment
  - Limit severe (maximum) delay at intersections
- General Traffic:
  - Limit negative impact on general traffic (through and cross)
- Overall:
  - Increase person throughput
  - Reduce person delay
  - Reduce variation in person travel time (through intersection and along corridor)

# Countywide Transit Signal Priority

- Transit vehicles in mixed flow without other priority measures
- No differentiation between types of transit service
- Transit riders and travelers in personal vehicles given equal weight (throughput)
- Signal coordination and traffic flow allowed to “recover” between instances of signal priority



# RTS Corridors – Signal Operations

- How should potential signal operations change when combined with other priority treatments options (queue jumps, exclusive guideway, etc.)?
- What types of transit service will be eligible for signal priority (RTS, Express, Local) and in which directions (peak, off-peak, cross)?
- How often should priority be granted when requested?
- What weights should be given to transit ridership versus general traffic?

# Transit Priority Treatment versus Signal Operations

ROW Treatments	Potential Signal Treatments*			
	Passive	Extend Green	Red Truncate	Insert Transit Phase
Non-RTS Corridor		✓	✓	
Mixed Flow		✓	✓	
Mixed Flow w Queue Jump	✓	✓	✓	Transit only Early Green
Dedicated Curb Lanes	✓	✓	✓	
Managed Lane (dedicated 1 way Pk)	✓	✓	✓	
1 Lane Median Busway (bi-dir)	✓	✓	✓	
1 Lane Median Busway (1 way)	✓	✓	✓	✓
2 Lane Side Busway (2 way)	✓	✓	✓	✓
2 Lane Median Busway (2 way)	✓	✓	✓	✓
LRT ROW (Purple Line)	✓	✓	✓	✓
* Also depends on allowed turns and transit service in guideway				

# Other Characteristics Impacting TSP and Signal Operations

ROW Treatments	Turns Permitted		Traffic Lane Use	Transit Service in Priority ROW			
	Right	Left		LRT	RTS	Express*	Local
Non-RTS Corridor	Y	Y	Y		N	Y	Y
Mixed Flow	Y	Y	Y		Y	Y	Y
Mixed Flow w Queue Jump	Y	Y	Right Trn		Y	Y	Y
Dedicated Curb Lanes	?	Y	Right Trn		Y	?	?
Managed Lane (dedicated 1 way Pk)	?	Y	Right Trn		Y	?	?
1 Lane Median Busway (bi-dir)	?	?	N		Y	?	N
1 Lane Median Busway (1 way)	Y	?	N		Y	?	N
2 Lane Side Busway (2 way)	Y	Y	N		Y	?	N
2 Lane Median Busway (2 way)	Y	N	N		Y	?	N
LRT ROW (Purple Line)	?	?	N	Y	?	N	N
					* Non-RTS WMATA, MTA, etc.		

Factors			
X street Fac. Type	Primary	Secondary	Local
X street Transit Service	RTS	High Freq	Low Freq
Bus stop location	Near	Far	
Bicycle & Pedestrian	Priority Area	Excess Ped Time	
HCM V/C Ratio	>0.6	<0.95	
Available Green time(phases)	Non-TSP phases > 1		
Time Since Last TSP Accuation	3 cycles for non-RTS corridor		
Ridership	Assume ridership > 100 pass /direction / hour		

# RTS Corridors and Proposed Treatments

- Handout under development
- Potential Corridors by # signals, RTS ROW type, stations, General traffic LOS, Major cross streets, etc.

# Questions/Issues

- Does the intersection cause significant signal delay to transit vehicles?
- Is there significant variability in the delay that transit vehicles experience that is greater than expected due to signal timing?
- Are transit vehicles caught in upstream queues and other congestion?
- Can transit vehicles avoid upstream queues and other congestion?
- Are there potential conflicts with other transit service when priority is granted (other main, or cross)?
- Are there physical constraints?
- Will there be significant impacts to the signal phasing (is there available green, etc.)?
- Will the person time savings and throughput increase (on main lines, on cross streets)?

**Same questions as Countywide TSP  
May have different Answers for RTS**